and rehabilitating fish facilities should greatly reduce the annual losses to these diversions. Improved screening at large Delta power plants should reduce entrainment and impingement losses of many important Delta fish species.

LEVEES, BRIDGES, AND BANK PROTECTION: Levee construction and bank protection have led to the loss of riparian, wetland, and shallow-water habitat throughout the Delta. Habitat improvement on levees and shorelines should help restore biodiversity and ecological functions needed for aquatic and wildlife resources of the Delta.

DREDGING AND SEDIMENT DISPOSAL: Reducing the loss of and degradation to important aquatic habitat and vegetated berm islands caused by dredging activities would protect, restore, and maintain the health of aquatic resources in and dependent on the Delta.

INVASIVE SPECIES: Over the past several decades, the accidental introduction of many marine and estuarine organisms has greatly changed the plankton and benthic (bottom and shore dwelling) invertebrates of the Delta. These organisms come mainly from the ballast waters of ships from the Far East. The introduction of these invasive species has had further ramifications up the foodweb. Further changes can be expected if restrictions are not made on ballast water releases into the San Francisco Bay and Delta. Border inspections and enforcement of regulations regarding ballast water releases should reduce the number of invasions each year to the Delta. Where invasive species have become a serious problem, possible means will be developed to control their distribution and abundance.

PREDATION AND COMPETITION: The numbers of predatory fish at certain locations in the Delta (e.g., Clifton Court Forebay) are high and contribute to the loss of resident and anadromous fish. Reductions in these local predator concentrations may reduce predation on important fish, including juvenile chinook salmon, steelhead, striped bass, and delta smelt. Predator control would also improve fish salvage at the State Water Project facilities at Clifton Court Forebay. Programs and projects that exclude fish such as salmon and delta smelt from areas that harbor concentrations of predators will contribute to reducing the adverse effects of predation.

CONTAMINANTS: Reducing toxin inputs in discharges and from contaminated sediments is essential to maintain water quality. Reduced concentrations in waters entering the Delta should lead to lower concentrations in Delta water and in fish and invertebrate tissues. Fewer health warnings for human consumption of Delta fish and improved foodweb productivity would also be expected.

HARVEST OF FISH AND WILDLIFE: The legal and illegal harvest of fish may limit recovery of some populations in the Delta and its watersheds. Increasing enforcement will help reduce illegal harvest of striped bass and sturgeon in the Delta. Increased enforcement and public education should lead to reduced frequency of violations per check by enforcement personnel.

STRANDING: The loss of aquatic organisms, primarily fish species, will be better understood and remedial actions developed and implemented. The primary focus of this effort will be in the Yolo Bypass.

DISTURBANCE: Boat traffic in the Delta contributes to the erosion of remaining shallow water, riparian, and wetland habitats along Delta channels. Reducing boat speeds and traffic in channels where remnant or restored habitats are susceptible to wave erosion damage would help preserve existing remnant habitat and ensure the success of habitat restoration efforts. Reduced rates of erosion and loss of shoreline habitats would be expected in areas of reduced disturbance. Enforcement and /or stricter boating regulations on bilge pumping, refueling, and oil changes will result in decreased contaminant loading and improve water quality. Boating also adversely affect two critical biological events in the Delta: spawning seasons for fish, particularly shallow water spawners such as delta smelt, and wintering periods for waterfowl and shorebirds.

VISIONS FOR SPECIES

DELTA SMELT: The vision for delta smelt is to recover this State- and federally listed threatened species. Recovery of the delta smelt population in the Delta will occur through improved Delta inflow, greater foodweb productivity, increased areas and quality of aquatic habitats, including the South Delta, and reduced effects of water diversions. Higher production should be apparent in dry and normal

water year types in response to improvement in flows, habitats, and foodweb and to reductions in stressors.

LONGFIN SMELT: The vision for longfin smelt is to recover this California species of special concern in the Bay-Delta estuary so that it resumes its historical levels of abundance and its role as an important prey species in the Bay-Delta aquatic foodweb. Achieving consistently high production of longfin smelt in normal and wetter years, which historically produced more abundant juvenile populations (year classes), will be critical to the recovery of longfin smelt.

SPLITTAIL: The vision for splittail is to recover this federally listed threatened species in order to contribute to the overall species richness and diversity and to reduce conflict between splittail protective measures and other beneficial uses of water in the Bay-Delta. Recovery of the Delta splittail population will occur through increased flooding of floodplains, higher late-winter Delta inflow, and improved tidal aquatic and wetland habitats. Greater production of young would be expected in dry and normal water year types.

GREEN STURGEON: The vision for green sturgeon is to recover this California species of special concern and to restore population distribution and abundance to historical levels. Restoration of this species contributes to overall species richness and diversity and reduces conflict between the need for protection for these species and other beneficial uses of water in the Bay-Delta. Green sturgeon would benefit from improved ecosystem processes, including adequate streamflow to attract adults to spawning habitat, transport larvae and early juveniles to productive rearing habitat, and maintain productivity and suitability of spawning and rearing habitat (including production of food).

CHINOOK SALMON: The vision for chinook salmon is to recover all stocks that are listed or proposed for listing under CESA or ESA. Central Valley chinook salmon populations will increase with improved late-winter and spring flows through the Delta, increases in wetland and floodplain habitats, lower spring water temperatures, an improved aquatic foodweb, and reduced effects of water diversions. Survival rates through the Delta should increase. Numbers of young salmon rearing in the Delta should increase with improved winter-spring flows and wetland habitats.

STEELHEAD TROUT: The vision for steelhead is to recover this federally listed threatened species. Steelhead will benefit from improved Delta inflow and outflow, channel hydraulics, and increased area of tidal marshlands. The vision is that restoration of ecological processes and habitats, along with a reduction of stressors, will contribute to stable and larger steelhead populations.

LAMPREY: The vision for anadromous lamprey is to maintain and restore population distribution and abundance to higher levels than at present. The vision is also to understand life history better and identify factors which influence abundance. Better knowledge of these species and restoration would ensure their long-term population sustainability.

SACRAMENTO PERCH: The vision for the Sacramento perch is to contribute to the recovery of this California species of special concern and to contribute to the overall species richness and diversity. Although extirpated from the Delta, restoration of Delta islands and heavily vegetated shallow water habitats may contribute to its restoration.

WHITE STURGEON: The vision for white sturgeon is to maintain and restore population distribution and abundance to historical levels. Restoration would support a sport fishery for white sturgeon and contribute to overall species richness and diversity and reduce conflict between the need for protection of this species and other beneficial uses of water in the Bay-Delta.

STRIPED BASS: The vision for striped bass is to maintain healthy populations, consistent with restoring natives species, to their 1960s levels of abundance to support a sport fishery in the Bay, Delta, and tributary rivers, and to reduce the conflict between protection of striped bass and other beneficial uses of water in the Bay-Delta. The striped bass population will benefit from increased inflows to the Delta in late winter and spring, an improved aquatic foodweb, and reduced effects of water diversions. Improvements in water quality and reducing summer losses to diversions may be important in the long-term recovery of striped bass. Given the high reproductive capacity of striped bass, improvements in production of young should quickly follow improvements in flow and foodweb and reductions in stressors.

AMERICAN SHAD: The vision for American shad is to maintain a naturally spawning population, consistent with restoring native species, to support a sport fishery similar to the fishery that existed in the 1960s and 1970s. Central Valley American shad populations will benefit from improved spring Delta inflow and an improved Delta aquatic foodweb. Populations would be expected to remain stable or increase. Increases would be expected in dry and normal rainfall years.

NON-NATIVE WARMWATER GAMEFISH: The vision for non-native warmwater gamefish is to maintain self-sustaining populations, consistent with restoring native species, in order to provide opportunities for consumptive uses such as angling.

NATIVE RESIDENT FISH SPECIES: The vision for native resident fish species is to maintain and restore the distribution and abundance of native species such as Sacramento blackfish, hardhead, and tule perch. Many native fish species will benefit from improved aquatic habitats and foodweb. Population abundance indices should remain stable or increase. The distribution of native resident fishes should increase with widespread habitat restoration. The extirpated Sacramento perch could be restored to new habitats in the Delta.

BAY-DELTA FOODWEB ORGANISMS: The vision for the Bay-Delta aquatic foodweb organisms is to restore the Bay-Delta estuary's once-productive food base of aquatic algae, organic matter, microbes, and zooplankton communities. Restoring the Bay-Delta foodweb organisms would require enhancing plankton growth and evaluating the need to reduce loss of plankton to water exports, particularly in drier years. Several options exist for enhancing plankton growth. Improving Delta inflow and outflow in spring of drier years will be an essential element of any plan. Another important element includes reducing the amount of toxic substances entering the system which may adversely affect foodweb organisms.

WESTERN SPADEFOOT: The vision for the western spadefoot is to maintain this California species of special concern in the Bay-Delta. Achieving this vision will contribute to overall species richness and diversity and reduce conflict between the need for its protection and other beneficial uses of land and water in the Bay-Delta. Protecting and restoring existing and additional suitable aquatic, wetland, and floodplain habitats and reducing the effect of other factors that can suppress breeding success will be critical to the recovery of the western spadefoot. Restoration of aquatic, seasonal wetland, and floodplain habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will help recover this species by increasing habitat quality and area.

CALIFORNIA TIGER SALAMANDER: The vision for the California tiger salamander is to maintain existing populations of this Federal candidate species in the Bay-Delta. Achieving this vision will contribute to overall species richness and diversity and reduce conflict between the need for their protection and other beneficial uses of land and water in the Bay-Delta. Protecting and restoring existing and additional suitable aquatic, wetland, and floodplain habitats and reducing the effect of other factors that can suppress breeding success will be critical to the recovery of the California tiger salamander. Restoration of aquatic, seasonal wetland, and floodplain habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will help recover this species by increasing habitat quality and area.

CALIFORNIA RED-LEGGED FROG: The vision for the California red-legged frog is to maintain populations of this federally listed threatened species. Achieving this vision will contribute to the overall species richness and diversity and to reduce conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. Protecting existing and restoring additional suitable aquatic, wetland, and riparian habitats and reducing mortality from non-native predators will be critical to achieving recovery of the California red-legged frog. Restoration of aquatic, wetland, and riparian habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will help in the recovery of this species by increasing habitat quality and area.

GIANT GARTER SNAKE: The vision for the giant garter snake is to contribute to its recovery in order to contribute to the overall species richness and diversity. Achieving this vision will reduce the conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. Protecting existing and restoring additional suitable wetland and upland habitats will be critical to achieving recovery of the giant garter snake. The

proposed restoration of aquatic, wetland, riparian, and upland habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will help in the recovery of this species by increasing habitat quality and area.

WESTERN POND TURTLE: The vision for the western pond turtle is to maintain the abundance and distribution of this California species of special concern in order to contribute to the overall species richness and diversity. Achieving this vision will reduce the conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. Protecting existing and restoring additional suitable wetland and upland habitats will be critical to achieving recovery of the western pond turtle. The proposed restoration of aquatic, wetland, riparian, and upland habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will help in the recovery of these species by increasing habitat quality and area.

SWAINSON'S HAWK: The vision for the Swainson's hawk is to contribute to the recovery of this State-listed threatened species to contribute to the overall species richness and diversity. Improvements in riparian and agricultural wildlife habitats will aid in the recovery of the Swainson's hawk. Increased abundance and possibly some nesting would be expected in the Delta as a result of improved habitats.

CALIFORNIA BLACK RAIL: The vision for the California black rail is to contribute to the recovery of this State-listed threatened species to contribute to overall species richness and diversity. Restoring emergent wetlands in the Delta should aid in the recovery of the California black rail. Population abundance and distribution should increase in the Delta.

GREATER SANDHILL CRANE: The vision for the greater sandhill crane is to contribute to the recovery of this State-listed threatened species in the Bay-Delta. Improvements in pasture lands and seasonally flooded agricultural habitats, such as flooded corn fields, should help toward recovery of the greater sandhill crane population. The population should remain stable or increase with improvements in habitats.

SHOREBIRDS AND WADING BIRDS: The vision for shorebird and wading birds is to maintain and restore healthy populations through habitat protection and restoration and reduction is stressors. Shorebirds and wading birds will benefit from restoration of wetland, riparian, aquatic, and agricultural habitats. The extent of seasonal use of the Delta by these birds should increase.

RIPARIAN BRUSH RABBIT: The vision for the riparian brush rabbit is to contribute to the recovery of this State-listed endangered species in the Bay-Delta through improvements in riparian habitat and reintroduction to its former habitat. Restoring suitable mature riparian forest, protecting and expanding the existing population, and establishing five new populations will be critical to the recovery of the riparian brush rabbit. Restoration of riparian habitats in the South Delta Ecological Management Unit of the Sacramento-San Joaquin Delta Ecological Management Zone and the East San Joaquin Basin Ecological Management Zone and adjacent upland plant communities will help the recovery of this species by increasing habitat area and providing refuge from flooding.

WATERFOWL: The vision for waterfowl is to maintain and restore healthy populations at levels that can support consumptive (e.g., hunting) and nonconsumptive (e.g., birdwatching) uses consistent with the goals and objectives of the Central Valley Habitat Joint Venture as part of the North American Waterfowl Management Plan. Many species of resident and migratory waterfowl will benefit from improved aquatic, wetland, riparian, and agricultural habitats. Increase use of the Delta and possibly increases in some populations would be expected.

PLANT SPECIES AND COMMUNITIES: The vision for plant species and communities is to protect and restore these resources in conjunction with efforts to protect and restore wetland, riparian, grassland, and upland habitats.

UPLAND GAME: The vision is to maintain healthy populations of upland game species at levels that can support both consumptive (e.g., hunting) and nonconsumptive (e.g., birdwatching) uses, through protection and improvement of habitats and reduction in stressors. Protecting and restoring existing and additional suitable grassland, seasonal and emergent wetland, midchannel island and shoal, and riparian habitats, and improving management of agricultural lands and reducing the effect of stressors

that can suppress breeding success will be critical to maintaining healthy upland game populations in the Bay-Delta.

NEOTROPICAL MIGRATORY BIRDS: The vision for the neotropical migratory bird guild is to restore and maintain healthy populations of neotropical migratory birds through restoring habitats on which they depend. Protecting existing and restoring additional suitable wetland, riparian, and grassland habitats will be critical to maintaining healthy neotropical migrant bird populations in the Bay-Delta. Large-scale restoration of nesting habitats will help reduce nest parasitism and predation by creating habitat conditions that render neotropical birds less susceptible to these stressors.

LANGE'S METALMARK BUTTERFLY: The vision for Lange's metalmark butterfly is to recover this federally listed endangered species by increasing its distributing and abundance through habitat protection and restoration.

DELTA GREEN GROUND BEETLE: The vision for the delta green ground beetle is to contribute to the recovery of this federally listed threatened species by increasing its populations and abundance through habitat restoration.

VALLEY ELDERBERRY LONGHORN BEETLE: The vision for the valley elderberry longhorn beetle is to recover this federally listed threatened species by increasing its populations and abundance through habitat restoration.

WESTERN YELLOW-BILLED CUCKOO: The vision for the western yellow-billed cuckoo is to contribute to recovery of this State-listed endangered species. There is no recent occurrence information for the yellow-billed cuckoo in the Delta. However, the cuckoo would become reestablished in the Delta and will benefit from improvements in riparian habitats. Improvements will result from efforts to protect, maintain, and restore riparian and riverine aquatic habitats throughout the Delta.

LISTED PLANT SPECIES: The vision for Mason's lilaeopsis, Suisun marsh aster, delta mudwort, delta tule pea, and delta coyote-thistle is to recover or contribute to the recovery of these species by integrating their habitat requirements into planning and implementation of projects to restore tidally influenced and other habitats.

WESTERN LEAST BITTERN: The vision is to maintain western least bittern and its habitat throughout the Delta by protecting and restoring forage, nesting, and roosting habitats in conjunction with other habitat restoration actions.

SIGNAL CRAYFISH: The vision for signal crayfish is to maintain populations at levels which will allow recreational and commercial harvest. Benefits for this introduced species will be indirect, resulting from streamflow modification, reduction in contaminant loadings, and restoration of tidally influenced shallow water habitats.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Attaining the vision for the Delta will involve a long-term commitment with short-term and long-term elements. Short-term elements include features that can and need to be implemented as quickly as possible either because of a long-standing need or a pressing opportunity. Plan elements where need, priority, technical and engineering feasibility, or cost effectiveness are questionable would be long-term. However, even long-term elements would in most cases benefit from short-term pilot studies that would address need, feasibility, science, and cost effectiveness.

Changes in freshwater inflow patterns to the Delta is a long-standing need; however, without developed supplies, the prescribed spring flows may not be possible in all year types. In the short-term, efforts would be made to provide the flows with available CVP water supplies in Shasta, Folsom, and New Melones Reservoirs using water prescribed by the Central Valley Project Improvement Act (§3406 b2 water) and additional water purchased from willing sellers (CVPIA §3406 b3 or CALFED purchased water). The effectiveness of water dedicated for such purposes would be maximized through use of tools such as water transfers. In the long term, additional environmental water supplies may be needed to meet all flow needs.

Related programs in this Ecological Management Zone include the CVPIA and Anadromous Fisheries Restoration Program, the SB 34 levee subvention program, Central Valley Habitat Joint Venture, the Riparian Habitat Joint Venture (a multiagency cooperative effort), Ducks Unlimited's Valley Care

program, the Nature Conservancy's Cosumnes River and Jepson Prairie Preserves, the USFWS's Stone Lakes Refuge, the DFG's Yolo Basin Wildlife Area, East Bay Park's Big Break and Little Franks Tract recreation areas, and outreach programs that compensate private landowners who improve wildlife management of their lands. The U.S. Army Corps of Engineer's program to mitigate for habitat losses from levee protection in the Delta should coordinate closely with the restoration program.

Much of the infrastructure to implement the vision for the Delta now exists. Existing programs could implement many of the restoration actions outlined in this vision. In areas where cooperative agency and stakeholder efforts do not now exist, such organizations can be developed to help implement the program. Cooperative efforts where agencies have formed partnerships to restore valuable aquatic, wetland, and riparian habitats in the east Delta would be supported and used as a model for other similar efforts (e.g., the Cosumnes River Preserve, with the Nature Conservancy and Ducks Unlimited). Other examples include the establishment of wildlife refuges at Stone Lakes and the Yolo Bypass, each with multiple partners and commitments. The California Department of Water Resources, DFG, and the U.S. Fish and Wildlife Service (USFWS) own considerable properties in the Delta (e.g., West Sherman Island Wildlife Area), which with funding support can be restored or upgraded to fit the vision. The Interagency Ecological Program (IEP) is an established research and monitoring unit that, with support, can accomplish the expanded evaluation and monitoring needs.

Endangered Species Recovery Plan Implementation

The ERPP will be an important, if not major, component in the successful implementation of recovery measures for species listed under either the State or Federal ESAs. For example, many of the targets and programmatic actions listed later in this section are derived from existing recovery plans. Two plans of major importance include the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (U.S. Fish and Wildlife Service 1996) and the NMFS Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon (National Marine Fisheries Service 1997).

Because the ERPP addresses endangered species from a broader ecosystem perspective, many restoration actions will benefit broad species communities and the habitats upon which they depend. These include actions to benefit aquatic and terrestrial fish and wildlife species as well as special plants and plant communities.

Central Valley Project Improvement Act

Restoring and maintaining ecological processes and functions in the Delta Ecological Management Zone will augment other important ongoing and future restoration efforts for the zone. The Anadromous Fish Restoration Program of the CVPIA (USFWS 1997) has a goal to double the natural production of anadromous fish in the system over the average production during 1967 through 1991. CVPIA authorized the dedication and management of 800,000 AF of CVP yield annually for the purpose of implementing the fish, wildlife, and habitat restoration purposes and measures that include water purchased for inflow to and outflow from the Delta.

Central Valley Habitat Joint Venture

The Central Valley Habitat Joint Venture is a component of the USFWS's North American Waterfowl Management Plan, with funding and cooperative project participation by federal, State, and private agencies. New funding sources, including CALFED restoration funds, are being sought to implement the Joint Venture. The Joint Venture has adopted an implementation plan that includes objectives to protect wetlands by acquiring fee-title or conservation easements and to enhance waterfowl habitat in wetlands and agricultural lands. Joint Venture objectives and targets have been adopted by the ERPP.

San Joaquin County Habitat Conservation Plan

The San Joaquin County Habitat Conservation Plan is nearing completion and describes mechanisms for offsetting past and future impacts associated with land use changes. The habitat conservation plan outlines an approach for acquiring lands using preservation criteria.

Delta Wildlife Habitat Protection and Restoration Plan

While not a formal plan, this plan is used to guide California Department of Fish and Game (DFG), USFWS, and other agencies' programs to wisely use and protect riparian and wetland habitats in the Bay and Delta. Its goals are to protect and improve habitat and inform the public of the magnitude of problems that threaten wildlife and their habitat. It also provides mechanisms for cooperation between local governments and State and federal agencies.

CALFED Bay-Delta Program

CALFED has funded over 20 ecosystem restoration projects in the Sacramento-San Joaquin Delta. Many of these projects deal with restoration of tidal aquatic habitat and screening of water diversions. Two of the more significant projects address the land subsidence problem, by studying methods to return the land to its pre-disturbance elevation. Department of Water Resources is allowing biomass to accumulate on Twitchell Island to reverse the subsidence. In another project, the United States Geological Survey is studying the movement and availability of sediment supplies in the Delta.

Linkage to Other Ecological Management Zones

Realizing the vision in this Ecological Management Zone depends in part on achieving the targets in the Sacramento River, Eastside Delta Tributaries, Yolo basin, and San Joaquin River Ecological Management Zones. Targets in the Suisun Marsh/North San Francisco Bay Ecological Management Zone should be pursued in combination with the Delta to restore important rearing habitats, reduce the introduction of contaminants, and control the introduction of non-native aquatic species. Meeting the flow needs for the Sacramento, Feather, Yuba, American, Mokelumne, Stanislaus, Tuolumne, and Merced rivers is essential to the Delta freshwater inflow needs. Aquatic, riparian, and wetland corridors in the Yolo and Eastside Delta Tributaries Ecological Management Zones are also directly linked and integral to habitat corridors in the Delta.

One important ecological process that needs further evaluation is sediment. The sediment budget of the Delta is of particular interest and there is a need to quantify sediment input, sediment depositional patterns in the Delta, and sediment output.

Restoration Targets and Programmatic Actions

Targets developed for the Sacramento-San Joaquin Delta Ecological Management Zone (and the 13 other ecological management zones) can be classified by their reliability in contributing to attainment of the Strategic Objectives. The target classification system used in the following section is as follows:

Class	Description
◆	Target for which additional research, demonstration, and evaluation is needed to determine feasibility or ecosystem response.
◆◆	Target which will be implemented in stages with the appropriate monitoring to judge benefit and success.
◆◆◆	Target that has sufficient certainty of success to justify full implementation in accordance with adaptive management, program priority setting, and phased implementation.

Ecological Processes

Central Valley Streamflows

General Target: The general target is to more closely approach the natural (unimpaired) seasonal Delta outflow patterns that:

- transport sediments,
- stimulate the estuary foodweb,
- provide for up and downstream fish passage,
- contribute to riparian vegetation succession,
- transport larval fish to the entrapment zone,
- maintain the entrapment zone and natural salinity gradient, and
- provide adequate attraction and migrating flows for salmon, steelhead, American shad, white

sturgeon, green sturgeon, lamprey striped bass, splittail, delta smelt, and longfin smelt.

Besides seasonal peak flows, low and varying flows are also essential elements of the natural Delta outflow pattern to which native plant and animal species have adapted. Specific targets for different flow pattern attributes may vary with the different storage and conveyance alternatives being considered in the CALFED Program.

TARGET 1: Provide a March outflow that occurs from the natural late-winter and early-spring peak inflow from the Sacramento River. This outflow should be at least 20,000 cfs for 10 days in dry years, at least 30,000 cfs for 10 days in below-normal water years, and 40,000 cfs for 10 days in above-normal water years. Wet-year outflow is generally adequate under the present level of development (◆◆).

PROGRAMMATIC ACTION 1A: Prescribed outflows in March should be met by the cumulative flows of prescribed flows for the Sacramento, Feather, Yuba, and American rivers. Assurances must be obtained (e.g., to limit Delta diversions) that these prescribed flows will be allowed to contribute to Delta outflow. A portion of the inflow would be from base (minimum) flows from the east Delta tributaries and the San Joaquin River and its tributaries.

TARGET 2: Provide a late-April to early May outflow that emulates the spring inflow from the San Joaquin River. The outflow should be at least 20,000 cfs for 10 days in dry years, 30,000 cfs in below normal years, and 40,000 cfs in above normal years. These flows would be achieved through base flows from the Sacramento River and flow events from the Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers (◆).

PROGRAMMATIC ACTION 2A: Prescribed outflows in late April and early May should be met by the cumulative prescribed flows from the Stanislaus, Tuolumne, and Merced rivers (see East San Joaquin Basin Ecological Management Zone), and Mokelumne and Calaveras rivers (see Eastside Delta Tributaries Ecological Management Zone). It will be necessary to obtain assurances that these prescribed flows are allowed to contribute to Delta outflow. The flow event would be made up of:

- the Cosumnes River,
- Mokelumne, Calaveras, and San Joaquin tributary pulsed flows prescribed under the May 1995 Water Quality Control Plan, and
- supplemental flows.

TARGET 3: Provide a fall or early winter outflow that approximates the first "winter" rain through the Delta (◆).

PROGRAMMATIC ACTION 3A: Allow the first "significant" fall/winter natural flow into the Delta (most likely either from rainfall or from unimpaired flows from tributaries and lower watersheds below storage reservoirs or from flows recommended by DFG and the Anadromous Fish Restoration Program [AFRP]) to pass through the Delta to the San Francisco Bay by limiting water diversions for up to 10 days. (No supplementary release of stored water from reservoirs would be required above that required to meet flows prescribed by DFG and AFRP.)

TARGET 4: Provide a minimum flow of 13,000 cfs on the Sacramento River below Sacramento in May of all but critical years (U.S. Fish and Wildlife Service 1995) (◆).

PROGRAMMATIC ACTION 4A: Supplement flows in May of all but critical years as needed from Shasta, Oroville, and Folsom reservoirs to maintain an inflow of 13,000 cfs to the Delta.

RATIONALE: *The proposed March supplemental flows were selected as a representative value for impact analysis in the Programmatic EIS/EIR. Throughout the ERP, the need to determine optimal streamflow for ecological processes, habitats, and species is repeated. The issues of supplemental flows are complex in term of ecosystem improvements. The frequency, magnitude, duration, timing and rate of change of streamflows that form channels, create and maintain riparian habitat (including all species of vegetation), and promote all life stages of the various aquatic species dependent on a particular stream will never occur within a single year. An optimal flow regime will have to vary, perhaps significantly, from year to year. The supplemental flow recommendations will be an intensive exercise in adaptive management and must be based on credible scientific underpinnings.*

Changing the seasonal pattern of freshwater flows into and through the Delta will help restore the

Delta's ecosystem processes and functions. This ecosystem restoration is fundamental to the health of aquatic, wetland, and riparian resources.

Providing Delta outflow at the prescribed level in dry and normal years in March will provide the following benefits:

- improve survival of juvenile chinook salmon rearing in and passing downstream through the Delta,
- provide attraction flows to adult winter-run and spring-run chinook salmon, steelhead, striped bass, white and green sturgeon, splittail, and American shad migrating upstream through the Delta to spawning grounds in the Sacramento River and its tributaries,
- provide attraction flows for longfin and delta smelt moving upstream within the Delta to spawn in the Delta,
- provide downstream passage flows for steelhead, splittail, longfin smelt, and delta smelt to move through the Delta to the San Francisco Bay,
- help maintain lower water temperatures further into the spring to benefit adult and juvenile salmon, steelhead, longfin smelt, delta smelt, and splittail,
- stimulate the foodweb in the Delta and Bay,
- reduce potential effects of toxins released into Delta waters,
- promote growth of riparian vegetation along Delta waterways, and
- reduce loss of eggs, larvae, and juvenile fish into south Delta water diversions.

Supplementing an existing prescription for late April-early May pulse flow through the Delta from the San Joaquin River will assist juvenile San Joaquin chinook salmon and steelhead moving through the Delta to the Bay. The added flow will also help transport Delta and San Joaquin plankton and nutrients that have built up during the spring to the western Delta and Suisun Bay where they will stimulate the spring foodweb on which many of the important fish species living in the Delta depend. In addition, this flow will provide many of the same benefits described above for the March flow event. The flow event would be provided by supplementing the prescribed pulse flow in the 1995 Water Quality Control Plan with additional waters purchased from willing sellers on the Mokelumne, Stanislaus, Tuolumne, and Merced rivers.

Restoring the natural first "fall" flow through the Delta will provide the following benefits:

- support spring-run and other chinook salmon, steelhead, and American shad juveniles migrating from the mainstem rivers and tributaries in passing through the Delta to the Bay,
- provide attraction flows for adult fall-run and late-fall run chinook salmon, splittail, longfin smelt, delta smelt, and steelhead migrating upstream into or through the Delta, and
- reduce losses of migrating juvenile fish in south Delta pumping plants.

Maintaining a minimum inflow of 13,000 cfs from the Sacramento River in May will help maintain survival and transport of striped bass eggs and larvae, and white and green sturgeon from the Sacramento River above Sacramento into the Delta. This flow will also benefit remaining downstream migrating juvenile chinook salmon and steelhead from the Sacramento River and its tributaries, as well as upstream migrating winter- and spring-run chinook salmon and American shad. Supplemental average monthly storage releases of up to 2,500 cfs for 30 days (150,000 total acre-feet) may be necessary in dry years to meet this requirement. In normal and wet years, flows would generally exceed 13,000 cfs. Implementation of this action requires the development and application of an adaptive management program that includes development of testable hypothesis and implementation of a monitoring program to collect and analyze the data to evaluate the hypothesis.

Providing for larger flows during the seasons with when those flows occurred historically, particularly in normal or dry years, will help restore important ecological processes and functions that create and maintain habitat in the Delta. Delta channel maintenance, sediment and nutrient transport, and introductions of plant debris are some examples of processes improved by flow events. Spring flow

events in dry and normal years will help sustain riparian and wetland vegetation.

COARSE SEDIMENT SUPPLY

TARGET 1: Maintain sediment supply to the Delta from upstream areas at levels needed to maintain existing habitats and to contribute to present and future efforts to reverse subsidence on Delta islands (◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative investigation to determine the existing sediment budget in the Delta based on sediment input, use within the Delta, and sediment output.

RATIONALE: *Natural sediments of streams, rivers, and estuaries consist of mineral and organic silts, sands, gravel, cobble, and woody debris. These materials naturally enter, deposit, erode, and are transported through the Bay-Delta and its watershed. Sediment, like water, is one of the natural building blocks of the ecosystem. Many other ecological processes and functions, and habitats and species require specific types and amounts of sediment and the habitats sediments create.*

Finer sediments are important in the natural development of riparian and wetland habitats. Major factors that influence the sediment supply in the Bay-Delta and its watersheds include many human activities such as dams, levees, and other structures, dredging, and gravel and sand mining.

River-transported sediments are an essential component of the physical structure and nutrient base of the Bay-Delta ecosystem and its riverine and tidal arteries. The size, volume, and seasonal timing of sediments entering the riverine and estuarine systems should be compatible with both natural and altered flow regimes. Sediment transport should match channel and floodplain characteristics of individual rivers, streams, and tidal sloughs. A specific sediment management objective is to redistribute sediment in the watersheds and valley components of the ecosystem. An appropriate level, rate, and size of sediment should be redistributed to match specific habitat requirements and ecological functions.

NATURAL FLOODPLAIN AND FLOOD PROCESSES

TARGET 1: Expand the floodplain area in the North, East, South, and Central and West Delta Ecological Management Units by putting approximately 10% of leveed lands into the active floodplain of the Delta (◆◆).

PROGRAMMATIC ACTION 1A: Convert leveed lands to tidal wetland/slough complexes in the North Delta Ecological Management Unit. Permanently convert island tracts (Little Holland, Liberty, and Prospect) at the south end of the Yolo Bypass to tidal wetland/slough complexes. Convert small tracts along Snodgrass Slough to tidal wetland/slough complexes. Construct setback levees along Minor, Steamboat, Oxford, and Elk Sloughs.

PROGRAMMATIC ACTION 1B: In the East Delta Ecological Management Unit, construct setback levees along the South Mokelumne River and connecting dead-end sloughs (Beaver, Hog, and Sycamore).

PROGRAMMATIC ACTION 1C: Remove levees that hinder tidal and floodflows in the headwater basins of east Delta dead-end sloughs (Beaver, Hog, and Sycamore) and allow these lands to be subject to flood overflow and tidal action.

PROGRAMMATIC ACTION 1D: Convert deeper subsided (sunken) lands between dead-end sloughs in the East Delta Ecological Management Unit east of the South Mokelumne River channel either to overflow basins and nontidal wetlands or to land designated for agricultural use.

PROGRAMMATIC ACTION 1E: Construct setback levees in the South Delta Ecological Management Unit along the San Joaquin River between Mossdale and Stockton.

PROGRAMMATIC ACTION 1F: Convert adjacent lands along the San Joaquin River between Mossdale and Stockton either to overflow basins and nontidal wetlands or to land designated for agricultural use.

PROGRAMMATIC ACTION 1G: Construct setback levees on corners of Delta islands along the San Joaquin River channel in the Central and West Delta Ecological Management Unit. Open leveed lands to tidal action where possible along the margins of the West Delta Ecological Management Unit.